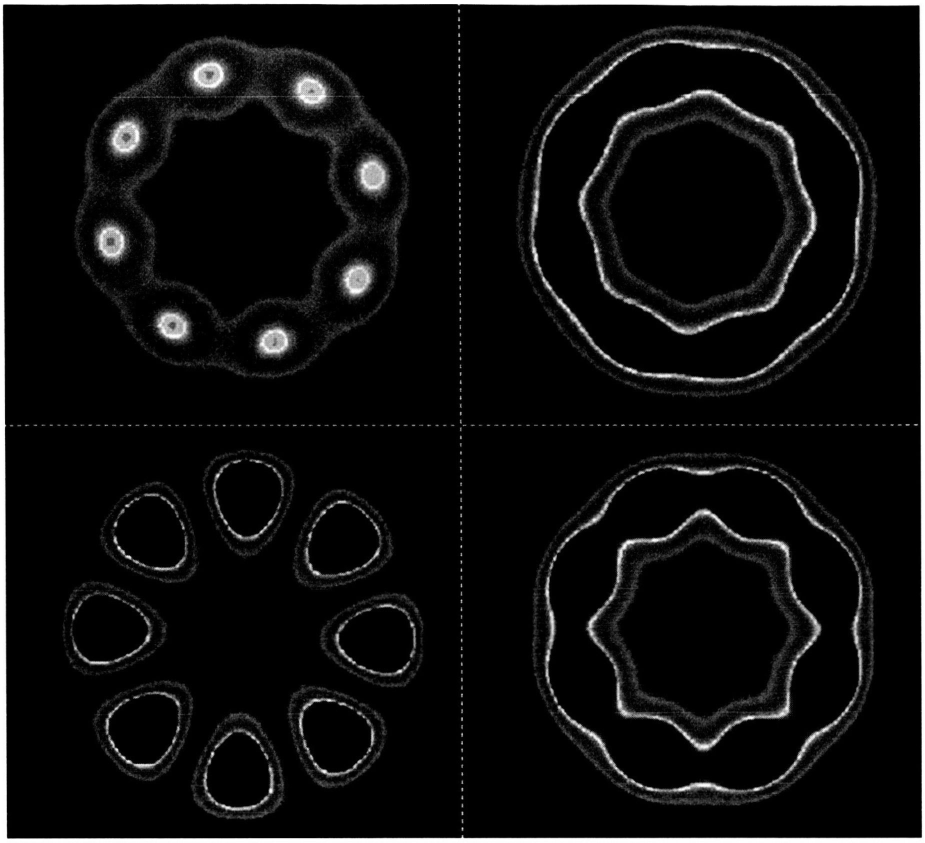

Fig. 1. The figure shows an example of the space-time-resolved computer simulation of the laser intensity pattern across the output facet. The four images show snapshots of the laser intensity at different times for a VCSEL with a current contact of the annular shape.

achieving terahertz emission through optical pumping by another laser. The first possibility is an optically pumped terahertz laser. The second approach is based on nonlinear optical wave mixing. Ames researchers have developed a theoretical model and computer simulation code that allows them to optimize the quantum-well structure design to achieve maximum nonlinear optical coefficients. Systematic theoretical and numerical simulation has shown the feasibility of generating radiation at a few terahertz by using this approach. This frequency is critical for the Earth Science Enterprise's atmosphere spectroscopy program and in far-infrared astronomy for the Space Science Enterprise. Efficient and compact terahertz sources will also find many commercial applications.

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A Liquifier for Mars Surface Applications

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NASA is planning an extensive set of robotic and human exploration missions that will make extensive use of cryogenic propellants. In-situ-consumable-production (ISCP) will reduce the mass launched from Earth by manufacturing propellant gases on the Mars surface. NASA's Exploration programs will benefit significantly from ISCP, providing that low cost, lightweight methods of propellant gas liquefaction are available to make exploration financially feasible.

The objective was to demonstrate that the planned 2003 Mars surface oxygen gas liquefaction requirement could be met with an existing, off-the-shelf tactical cryogenic cooler and a simple heat exchanger. The requirement is that oxygen gas produced during the daytime on the Mars surface (typical temperature environment of 240 K) be liquefied at a rate of 12.6 grams per hour (g/hr) and stored at a pressure of 0.2 atmospheres (atm) (0.2 megapascals (MPa)).

Figure 1 shows a schematic of the test setup. Using nitrogen as a surrogate test gas (for safety reasons), N_2 gas at room temperature was supplied to a liquefier in an environmental chamber nominally maintained at 240 K. System pressure was 2 atm (0.2 MPa). An average liquefaction rate of 9.1 g/hr of nitrogen was realized over a 3.55-hour period. The equivalent oxygen liquefaction rate is obtained by considering both the increase in refrigeration capacity of the cooler at the higher oxygen liquefaction temperature and the ratio between the total enthalpy changes of oxygen and nitrogen when cooled from room temperature and liquefied. It follows that liquefying nitrogen at a rate of 9.1 g/hr corresponds to an oxygen liquefaction rate of 12.9 g/hr. This exceeds the planned demonstrations for the 2003 Mars mission goal by 2%.

The more formidable challenge remains to demonstrate that the 2,500 g/hr requirement for the later human missions can be met with an economically feasible package.

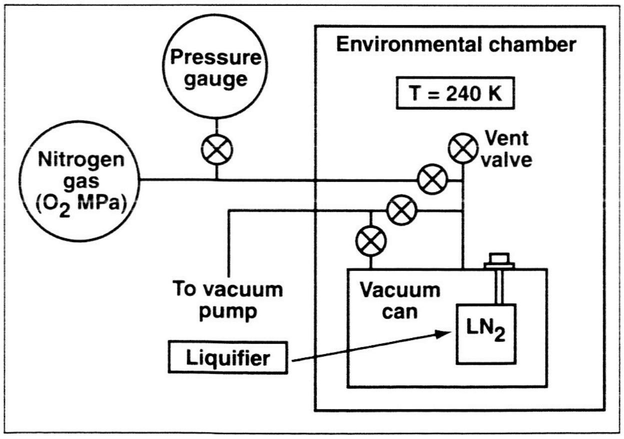

Fig. 1. Liquefier test setup.

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Integration of Pressure-Sensitive Paint Data to Obtain Loads

James Bell

A primary reason for developing pressure-sensitive paint (PSP) for wind tunnel testing has been the desire to use PSP in measuring aircraft loads. This would obviate the need for a separate loads model and test, as well as make loads data available much earlier in the design cycle than is presently the case. However, the ability of PSP to deliver accurate loads data cannot be validated until integrated pressures from PSP have been shown to give accurate force and moment values.

The main objective was to modify the current PSP data reduction code to support integration of pressure data over a model surface grid and to compare PSP-derived force and moment measurements with those obtained from the balance.

The current PSP data reduction code already produces pressure maps that are projected onto a model surface grid. This code was modified to produce integrated force and moment values by summing the mean pressure on each surface panel and multiplying it by the panel area. To verify the method, forces were computed from PSP data taken during a test of a semispan wing in the Ames Unitary Wind Tunnel in October 1993. Figure 1 shows a view of surface pressures on the wind tunnel model, together with the surface grid. This test was chosen because of the relatively simple model geometry, and because PSP data were available over the top and bottom of the wing.

The integrated PSP data are compared to balance data in figure 2, which shows lift coefficient computed using both methods. Values agree to within less than 3% except at the high positive and negative angles of attack. At these angles the model half-body, which was not coated with PSP and is thus not included in the pressure integration, begins to contribute substantially to the lift.

It remains to extend the pressure integration method to calculating moments, and to calculations for more complex aerodynamic shapes.

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